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Midway

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MWLSF

*Health Study
RHS.*

FEB 4 1987

Superfund Branch

February 2, 1987

Dear Addressee:

Attached is the final draft of Dr. Tom Burbacher's executive summary of his study on possible health studies for Midway landfill. While his full report is not yet available for review, the executive summary includes essentially everything in the full report.

Would you please review this draft and send comments to us by February 16, 1987? We will either amend the final executive summary or attach your comments to it. It is our hope to hold a public meeting on the report by the end of February.

Your assistance and expertise is always appreciated.

Sincerely,

Charles F. Kleeberg
Charles F. Kleeberg, Director
Environmental Health Division

CFK:mw
Att.

*This is not yet a
Public report. Please
respect affected agencies'
opportunity to comment
in place.*

Charles
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EXECUTIVE SUMMARY

EVALUATING THE PUBLIC HEALTH OF HAZARDOUS WASTE SITE COMMUNITIES:
CURRENT FEDERAL AND STATE POLICIES AND RECOMMENDATIONS
FOR THE MIDWAY LANDFILL COMMUNITY

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Prepared for:

The City of Seattle
Engineering Department
Solid Waste Division

The community surrounding the Midway Landfill in Kent, Washington has voiced concerns regarding the potential public health problems associated with living near the landfill for many years. These concerns include but are not limited to cancer, reproductive dysfunction, birth defects, respiratory disorders, chronic headaches and nosebleeds, learning disabilities, and memory loss. Public health concerns have intensified during the past two years with the inclusion of the Midway Landfill on the Environmental Protection Agency's National Priority List of Hazardous Waste Sites. In response to the growing concerns of the Midway community, the author of this report was contracted to review the various policies regarding the investigation of public health problems in hazardous waste site communities. The primary purpose of this review was to evaluate procedures that have been used in response to community health concerns, so as to develop recommendations regarding the appropriate options for the Midway Landfill community.

The report is based on information collected (i) from numerous local meetings with health department representatives, citizen groups, and individual residents in the community, (ii) from discussions with representatives from the Environmental Protection Agency, the Centers for Disease Control, the Agency for Toxic Substances and Disease Registry, the Citizen's Clearinghouse for Hazardous Waste and Health Departments in 18 states and (iii) from reviews of over 100 published and unpublished reports from scientific journals, public health groups, and state health department files.

The report includes an overview of the national toxic waste problem, a review of scientific literature related to the evaluation of the public health consequences of hazardous waste sites, a description of Federal, State, and a citizen's group programs for evaluating the health problems of hazardous waste site communities and a list of recommendations for establishing an Environmental Health Evaluation and Education Program to meet the concerns of the Midway Landfill community.

THE NATIONAL TOXIC WASTE PROBLEM

In 1980, the United States Congress established the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (1). This act created what is commonly known as the Superfund Program under the

direction of the Environmental Protection Agency (EPA). The EPA established a National Priority List (NPL) of hazardous waste sites. This list now contains over 700 sites with at least one site in nearly every state in the country (2).

Estimates from the EPA indicate that nearly 2,000 waste sites eventually will require Superfund cleanup (3). Statistics from the Office of Technology Assessment (OTA), however, indicate that the EPA has grossly underestimated the future requirements and that over 10,000 hazardous waste sites will require cleanup (3). The cost of cleaning the estimated 10,000 hazardous waste sites could easily be \$100 billion and could take 50 years to accomplish.

EVALUATING THE PUBLIC HEALTH CONSEQUENCES OF HAZARDOUS WASTE SITES: A REVIEW OF SCIENTIFIC LITERATURE

The requirements for a rigorous Epidemiological evaluation of the human health effects of hazardous waste sites were reviewed in a series of articles published from a 1981 conference on "Research Needs for Evaluation of Health Effects of Toxic Chemical Waste Dumps" (4). An article in this series (5) summarized four principles which should guide the evaluation of persons exposed to hazardous wastes. These principles included (i) the documentation of the nature and extent of the exposure, (ii) the precise definition of the exposed populations, (iii) the specific diagnoses of the disease in the exposed (and control) populations, and (iv) the rigorous evaluation of the relationship between exposure and disease which, if possible, should include the detection of any dose-response relationships.

Other articles have been published in an attempt to provide discussions of the above principles in light of the practical limitations of community health studies associated with hazardous waste sites (6-10). These limitations include exposures that are poorly defined, disease patterns that are not well identified, and a poor understanding of the relationship between other biological factors and illness in man. The articles point out that while the scientific principles associated with defining the health effects of toxic exposures should be utilized in health studies of hazardous waste site communities, these health studies are often part of public service programs that do not meet rigorous scientific standards. These programs, however, fulfill several important practical functions such as providing timely quantitative information about alleged problems in the community, separating

the facts regarding community complaints from rumors, and communicating environmental and public health information to the community to place their fears in proper perspective.

In addition to the above articles, there have been four major reviews of hazardous waste site community health studies published during the past two years (11-14). A summary of the studies included in these reviews is shown in the attached Table. In general, health studies of hazardous waste site communities have repeatedly demonstrated increases in subjective illnesses (e.g., headaches, respiratory distress, nosebleeds, etc.). These results, however, may be influenced by recall bias in the waste site community and do not provide direct evidence of hazardous waste site health effects. In addition, most health studies of hazardous waste site communities have not produced scientific evidence relating serious health effects to hazardous waste sites. Due to limitations in past study designs, sample sizes, and statistical approaches, however, this lack of scientific evidence may also provide an inaccurate assessment of the potential health effects of these sites. As a result, very few general conclusions regarding the health effects of hazardous waste sites can be offered at this time. Reports of increased rates of subjective or nonspecific illness in hazardous waste site communities are considered significant by some, while others stress the limitations of self reported data. The lack of evidence linking hazardous waste sites with serious disorders (e.g., cancer, birth defects) and death may only be relevant for the short term, yet current studies do not provide adequate follow-up data. Although new technologies may assist in the future determination of individual exposures and affects, current methods for identifying exposed members of the community are extremely nonspecific. The only consistent conclusion that has been offered thus far is that there is a critical need for more data concerning the health effects of hazardous waste sites. However, approaches that are being utilized to address this critical need vary as greatly as the current assessment of the waste site situation.

FEDERAL, STATE AND A CITIZEN'S GROUP PROGRAMS

The 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) authorized the EPA to direct the Superfund Program. In addition, the act called for the creation of a new agency under the Department

of Health and Human Services (DHHS) called the Agency for Toxic Substances and Disease Registry (ATSDR). While the EPA was given the major responsibilities regarding hazardous waste site identification, investigation, and cleanup, the ATSDR was given the responsibility to "effectuate and implement the health related authorities of the act" (1). The EPA process includes an assessment of the potential public health impact of each site that is considered for the National Priority List (NPL). The assessment of the potential public health consequences of the hazardous waste site is also an important part of the Superfund Remedial Program (15). The Remedial Program has two phases, the remedial investigation and the feasibility study. The Remedial Investigation/Feasibility Study (RIFS) can be developed under the direction of the EPA or the state where the hazardous waste site is located. The party responsible for the hazardous waste site can also be involved in developing the RIFS, negotiating with the EPA or the state. EPA policy regarding public participation in this process, according to the Office of Technology Assessment (3), is to exclude the public from all negotiation sessions (regarding the RIFS), but to provide periodic information about the progress of negotiations.

The primary health aspect of the RIFS involves the development of a public health evaluation of the site. Current EPA guidelines, however, do not emphasize aspects of the public health evaluation that would necessitate surveying the hazardous waste site community. Consequently, resources are not typically provided for epidemiological studies of the nearby community. Activities related to hazardous waste site communities are usually limited to those included in a public relations program, which focuses on disseminating information regarding the site investigation.

In addition to the public health evaluation, EPA or the state can request the assistance of the ATSDR for health assessments or health studies. According to a memorandum of understanding between ATSDR and EPA (16), the criteria that should be used for requesting assistance from ATSDR includes: "Whether the presence of toxic substances has been confirmed at the site, whether pathways of human exposure to toxic substances have been demonstrated to exist at the site, especially if such pathways involve direct contact with toxic substances, and whether a human population has been exposed to toxic substances via the identified pathways, and whether there exists a threat of current or future health effects to the population being so exposed, after

considering EPA's risk assessments or health effects information from other sources." These criteria require a considerable amount of data concerning the type and extent of contamination from the hazardous waste site, as well as specific data regarding human exposures. The RIFS process provides this data very slowly (sometimes over several years) and in many instances this process does not provide this data at all (because exposures may be transient, episodic, or poorly documented). Formal requests for assistance from ATSDR, therefore, usually do not take place until very late in the RIFS process, after the environmental investigation of the hazardous waste site is complete. Currently, there are no EPA regulations requiring ATSDR or local health experts to participate in developing the RIFS process. Decisions concerning the type and extent of monitoring for possible past and present human exposures to hazardous wastes, therefore, usually take place without direct community or public health representation.

Criteria for performing health studies of hazardous waste site communities or developing Exposure/Outcome Registries of persons exposed to hazardous waste have been proposed by ATSDR and the Center for Environmental Health (CEH), Centers for Disease Control (17-19). One report included a list of criteria for use in assessing the feasibility of health studies of hazardous waste site communities. According to this report, health studies should be considered feasible (i) when biological levels indicating the time period and level of exposure are available or can be obtained; (ii) when the possible effects of the exposure are known, based on human data; (iii) when the health effect is relatively specific or is caused only by the exposures; (iv) when enough people are exposed to allow statistically valid conclusions from the study; and (v) when adequate resources and local cooperation are available. The above criteria regarding health studies and registries were developed, according to an ATSDR Health Study Plan, because so little information exists regarding the effects on humans of long term low level exposure to chemicals or chemical mixtures. These criteria, according to this plan, prioritizes those studies that will have the greatest impact for establishing a relationship between chemical exposure and illness. These criteria, however, severely restrict the role of the ATSDR in most health investigations of hazardous waste sites. While the criteria are based on sound scientific principles for evaluating health effects of toxic exposures, strict adherence to these principles will only perpetuate the current lack of

data regarding health problems of hazardous waste site communities. In addition, these criteria, like those of EPA, do not provide the impetus for early and continued public health input into the site investigation process (RIFS), even though it is this process that will eventually determine the public health impact of the site on the nearby community. While ATSDR and CDC have conducted or participated in studies at several (NPL) sites these studies usually were limited to the collection of biological samples for establishing exposure to chemicals and cross-sectional procedures to evaluate health effects. Few follow-up studies have been performed to date, and thus far no registries of persons exposed to hazardous waste from (NPL) sites have been developed by ATSDR.

While the federal programs described above were developed to address health issues at hazardous waste sites, the primary responsibility for responding to questions, requests, and demands of hazardous waste site communities still rests at the state and local health department level. Programs developed by state and local health departments to address community health concerns are of paramount importance then, since these programs will ultimately determine the type and scope of the response.

For this report, information regarding state programs was obtained via three procedures; (i) by reviewing published articles of health studies of hazardous waste site communities; (ii) by reviewing unpublished articles from health department files; and (iii) by a telephone survey of 18 state health departments. The results of state survey indicate that while various approaches have been utilized across states a few general principles can be stated. Nearly all of the health departments surveyed indicated that (i) local community representatives had requested information and/or studies regarding the health problems in a hazardous waste site community; (ii) the state health department typically takes the lead in responding to these requests in order to provide a consistent approach and due to the limited resources at the local level; (iii) in response to these requests, state registries and/or vital statistics records are initially reviewed to investigate serious health problems such as cancer, birth defects, and mortality; and (iv) health studies of hazardous waste site communities are almost always initiated by pressures from the potentially affected community. In addition, for those states that have sponsored large scale community health studies (6 of the 18 states surveyed), the resources for these studies have typically come from funds from State Superfund Programs.

The community health studies sponsored by the states surveyed have used indirect measures of exposure due to the lack of information regarding individual exposures to hazardous wastes. In addition, most studies have relied on self reported symptoms and disease to measure the effects of the hazardous waste site on the community. The results of these studies have indicated that hazardous waste site communities report more and more frequent common symptoms such as respiratory distress, skin rashes and headaches, but do not report increases in serious problems like cancer, birth defects or mortality. Waste site communities have also consistently reported poorer estimates of perceived health than control communities.

In general, the results of the health studies have not altered the course of action of the hazardous waste site remediation. Most of the studies have concluded that the increased reported symptoms would subside when the problems at waste site were mitigated. According to these studies, site mitigation would also remedy the problems associated with poor perceived health in the community. No direct investigations to substantiate these conclusions, however, have been performed to date.

Finally, the Citizen's Clearinghouse for Hazardous Wastes has published 2 reports concerning community health studies (20,21). In general, the approach of the Clearinghouse at this time is to advise communities to refrain from demanding a definitive study of the cause of the health problems in their area but to emphasize the need to define the type and extent of health problems as an initial step in the environmental and health investigating process.

RECOMMENDATIONS FOR MIDWAY HEALTH EVALUATION AND EDUCATION PROGRAM

The results of the review of federal and state programs indicate that there are a variety of approaches being used to address the concerns of hazardous waste site communities across the country. Some of these approaches include methods for surveying the health problems of the community, while others do not. As a result, justification for a wide range of approaches can be made based on historical precedent. A simple blueprint that can be followed in developing a health evaluation program is not available at this time.

Midway

The recommendations that are listed below were developed as a result of an assessment of the various options that are available to provide information regarding the health of the Midway Landfill community. The purpose of the recommendations is to develop a Health Evaluation and Education Program that will provide:

- (i) a public forum for an ongoing discussion of health related issues in the community as well as general issues related to environmental risk;
- (ii) greater public health representation in the decision processes related to environmental monitoring of the site;
- (iii) a comprehensive review of available environmental monitoring data from a public health perspective,
- (iv) a greater role for the State Health Department in evaluating the environmental monitoring program and establishing a health program for the community, and
- (v) a process, during the site investigation, that will provide quantitative, reliable data regarding the public health problems in the community to better respond to the needs of the feasibility study and the concerns of the community.

RECOMMENDATION 1. Response to Report: Community and Agency Comments

Prior to implementing the recommendations regarding the Health Evaluation and Education Program, written comments regarding this report should be solicited and incorporated into an appendix for general review. The author has agreed to respond to written comments, if necessary, by amending the report or providing additional information. Written comments should be solicited from representatives of the:

- (i) Citizen's Advisory Committee
- (ii) Seattle-King County Department of Public Health
- (iii) Washington State Department of Social and Health Services
- (iv) Washington State Department of Ecology
- (v) Environmental Protection Agency
- (vi) Agency for Toxic Substances and Disease Registry

- (vii) University of Washington's Ad Hoc Committee on Midway
Landfill Hazards
- (viii) Midway Action Group

The comments of the citizen's advisory committee should represent the views of the committee as well as a summary of the views of the community. The views of the community should be solicited via a public meeting headed by the author of this report and the citizen's advisory committee. Individual citizens should also be encouraged to provide written comments if they desire to do so.

RECOMMENDATION 2. Exposure/Health Effects Evaluation

The University of Washington's Ad Hoc Committee report entitled "Evaluation of Potential Health Effects Associated with Off-Site Gas Extraction Systems at the Midway Landfill" is, thus far, the only document that provides a summary and evaluation of the environmental monitoring data from a public health perspective. This document was developed from very limited data pertaining only to exposure to gaseous emissions from extraction wells.

The Department of Ecology is currently in the process of creating a data base management system for all of the environmental monitoring data that has been collected since the Superfund investigation of the Midway Landfill began. This data base should be supplemented with any environmental monitoring data that was collected prior to this investigation, especially during the period that the landfill was in operation. The entire data base, then, should be reviewed and a feasibility study developed to assess whether an Exposure/Health Effects Evaluation of past and present conditions in the landfill community can be performed. If an Exposure/Health Effects Evaluation is considered feasible (i.e., will provide a more comprehensive review on the health risks than available to date), support for the development of this evaluation should be provided by the Department of Ecology. The Exposure/Health Effects Evaluation should provide information similar to the University's Ad Hoc Committee report, although discussion of noncarcinogenic effects (reproductive, neurotoxic) including issues related to the reporting of an exacerbation of numerous common symptoms should be included.

Recommendations for future environmental monitoring for more rigorous public health evaluations should also be included.

RECOMMENDATION 3. Remedial Investigation/Feasibility Study (RIFS) Health Effects Evaluation

The current RIFS plan was developed primarily through negotiations between the Department of Ecology and the City of Seattle. While the Environmental Protection Agency must review and approve the RIFS plan, no such review is required by health experts or any health agency. A review of the RIFS plan to determine whether the current site investigation will provide adequate information for a comprehensive evaluation of the health risks to the surrounding community is recommended. This review should be part of the Exposure/Health Effects Evaluation (see recommendation 2), since previous environmental monitoring data will influence the requirements of the current RIFS. This review, as part of the Exposure/Health Effects Evaluation, should be supported by the Department of Ecology.

Finally, a representative of the state health department should be included in future negotiations regarding the site investigation and should report on the progress of the site investigation to the Health Evaluation and Education Work Group.

RECOMMENDATION 4. Formation of a Health Evaluation and Education Work Group

While numerous committees have been established to discuss issues related to the remedial investigation, a format has yet to be established that would provide an adequate ongoing discussion of the health concerns of the community. It is recommended, therefore, that a community Health Evaluation and Education Work Group be established to provide a continuous format for the discussion of health related issues. This work group should include representatives of the Midway Landfill community (including health providers who live in or serve the community) and the State Health Department, the City of Seattle, the Seattle-King County Health Department, the Department of Ecology and local EPA and CDC representatives. The meetings of the Work Group should be co-chaired by a representative of the Midway community and a

representative of the State Health Department and should be open to all interested Midway Landfill residents. The functions of this work group should include:

- (i) prioritizing the health evaluation tasks listed below or proposed by others;
- (ii) evaluating the appropriate administrative procedures for implementing health evaluation tasks (e.g., internal agency health experts vs external consultants or contractors);
- (iii) evaluating proposals for implementing health evaluation tasks;
- (iv) recommending health evaluation scientists to implement the tasks;
- (v) evaluating reports regarding the site investigation from the public health representative for agency meetings and negotiations;
- (vi) providing ongoing oversight of the implementation of health evaluation tasks;
- (vii) evaluating the results of health evaluation tasks; and
- (viii) disseminating information regarding the objectives, procedures and results of health evaluation tasks to the Midway community.

SOME HEALTH EVALUATION TASKS FOR CONSIDERATION BY THE HEALTH EVALUATION AND EDUCATION WORK GROUP

The following health evaluation tasks are provided for discussion by the work group. These tasks are included because they can provide quantitative information concerning the health status of the community during the site investigation. Other tasks should be considered by the Work Group, as well as factors that influence the likelihood that these tasks can be implemented (e.g., funding source, availability of health experts), a task beyond the scope of this report.

In general, studies of the Midway Landfill community could make use of existing sources of data, or they could generate additional data through interviews and abstraction of medical records. Common to all these approaches, however, is the need to define what portion of the population is "at risk". Given the current lack of information about what kinds of environmental exposure information will be available in what form and when, it

makes sense to devise a flexible way of defining this population. The 1980 census block coding system would probably be a useful tool in this process. Census blocks (CB's) are subdivisions of census tracts defined in such a way as to try to keep the number of people in each block approximately the same: in urban areas, they are basically one city block, in less dense areas they are correspondingly bigger. This could form the basis for analyses in the following ways:

- (i) In the absence of any detailed environmental information, all CB's making up the "affected area" around the landfill (based on the best available data) would become the exposed group, and all other CB's within the adjacent census tracts or King County as a whole could make up a comparison group. This type of external comparison group would be most useful for information that is not subject to possible biases in reporting, such as cancer registry data.
- (ii) As additional environmental data become available, each CB could be assigned a simple (2 or 3 level) code for each "exposure" (e.g. CB-1 might be high-exposed for migrating methane, but low-exposed for a different contaminant). Any available medical event data (having been coded to the appropriate CB could then be reanalyzed for associations with each exposure type. In this case, the comparison group would be strictly internal, that is, persons near enough to the landfill to be sensitized to the medical issues related to it, but far enough away to be unlikely to be affected medically. This method would be particularly useful for more common but subjective health outcomes generated from health surveys.

TASK 1. Cancer Study: Census Blocks

The Fred Hutchinson Cancer Research Center's Cancer Surveillance System (CSS) has been in place since 1974. With cooperation from the 58 area hospitals, as well as private pathology laboratories, the CSS identifies over

99% of incident cancers occurring in the 13 counties of western Washington. This information is coded to the census tract (CT) level. By coding all cancers identified by the CSS in a defined geographic area to the census block level, the incidence rates for this population in this area (as well as any subpopulation that could be defined based on more detailed exposure assessments) could be calculated and compared to rates from King County as a whole. One limiting factor to this type of study might be that the size of the population exposed would not be large enough to detect small differences in cancer incidence. The results of the cancer registry study will indicate, however, whether large increases in rates of cancer have occurred in the Midway Landfill area in general or the exposed areas in particular.

TASK 2. Birth Certificate Study: Census Blocks

Birth certificate data are also available with pre-coded census tract information. The 1984 and 1985 data have check-boxes for congenital malformations which seem to improve the reporting of them (at least those identified in the first several days of birth). These data could be analyzed in much the same way as the cancer data: coded down to the census block level, assigned exposures based on best available information, and compared to the experience of King County as a whole. In addition, other adverse outcomes of interest, such as low birthweight, low Apgar scores, and previous spontaneous abortions could also be examined using birth certificate data. Again, the size of the exposed population will limit the ability to detect small increases in these outcomes. The results of the birth certificate study will indicate, however, whether large increases in rates of poor pregnancy outcomes have occurred in the Midway area in general or the exposed areas in particular.

TASK 3. Community Health Survey: Current Population/Census Blocks

While the results of the cancer registry and birth certificate studies provide important information regarding these health outcomes, the health problems that are usually reported by hazardous waste site communities can be examined initially via a health survey. Due to the numerous problems inherent in survey research, however, a health survey, if implemented, should be

considered only the first phase of an investigation regarding the prevalence of common diseases and illnesses in the community. Depending on the outcome of the survey (i.e., which diseases are reportedly increased), follow-up studies to validate certain conditions by review of medical records or physician examinations should be considered. In addition, procedures to minimize and estimate the influence of recall bias should be considered important components of any health survey procedure. In the opinion of this author, the survey design that would best respond to the concerns of the community would utilize a face-to-face or telephone interview of all families in a defined study area and would attempt to interview families again after the site investigation and cleanup is complete or after they have moved from the Midway community. Possible alternatives, however, such as utilizing the community for distributing a self-administered survey or reducing the number of families surveyed, should be discussed by the Health Evaluation and Education Work Group.

TASK: 4. Midway/Parkside School Study: Current Population

Many of the health problems reported by Midway residents have been observed in children who live in the area. Several residents have requested that children from the Parkside and Midway schools be studied, since children from inside and outside the Midway community are now attending these schools. Particular concern for young children (grades 1-3) that are now being bused from outside the Midway area to Parkside school has been expressed. Procedures for studying the health problems of children from the Parkside and Midway school would not involve extensive resources in addition to the health survey (Task 3). Parents of children attending the Parkside and Midway schools who do not live in the Midway area could be identified from school records and included in the health survey. In addition, information regarding possible changes in the perceived health of these children could be collected to examine possible psychological influences associated with living near the landfill. Such a study would involve the children directly and could be carried out by qualified professionals at the respective schools.

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SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES

<u>SITE</u>	<u>NPL#</u>	<u>EXPOSURES</u>	<u>RESULTS</u>
Triana/Tennessee River, AL	31	Serum DDT levels in exposed residents	Altered lipid & liver metabolism
Tucson International Airport Area, AZ	70	Exposed & control areas TCE in well water	↑ School absenteeism, no ↑ defects & mortality
Mountain View Mobile Home Estates, AZ	94	Asbestos in air, soil & dust of exposed residents	No current asbestos related diseases
Vertac Inc., AR	18	Urine levels of 11 chemicals related to herbicide exposure in exposed & control children	No health problems studied
Stringfellow, CA	32	Exposed & control areas Multiple contaminants	↑ Earache, nausea, headache, skin rash, sinus blockage, dizziness
Operating Industries, CA	71	Exposed & control areas Multiple contaminants	↑ Headache, nausea, eye & skin irritation, tiredness; no ↑ death, cancer, pregnancy problems
Purity Oil, CA	280	NR	NR
McColl, CA	335	Exposed odor areas & control area, Multiple petroleum contaminants	↑ Headache, nervousness & other "bothersome" symptoms
Fairchild Camera & Instrument Corp., CA	P	Exposed & control areas TCE & DCE in well water	↑ Spontaneous abortions & birth defects
Del Amo, CA	NL	Exposed & control areas Multiple contaminants	NR
BKK Landfill, CA	NL	Exposed & control areas Multiple contaminants	No ↑ skin rashes & cancer

SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES (Continued)

<u>SITE</u>	<u>NPL#</u>	<u>EXPOSURES</u>	<u>RESULTS</u>
Bunker Hill Mining & Metallurg Complex, ID	106	Blood lead levels in exposed children	↑ Lead toxicity (BL > 25 µg/dl & EP > 35 µg/dl), anemia; ↓ nerve conduction velocity
Neal's Landfill (Bloomington), IN	290	Serum PCB levels in exposed & control residents	Altered lipid metabolism
Calcasieu Parish, LA	NL	Exposed & control areas Multiple contaminants	↑ Eye, respiratory & other reported symptoms associated with "reporting bias"
New Bedford Site, MA	80	Serum PCB levels in exposed residents	No health problems studied
Silresim Chemical Corp., MA	293	Exposed & control areas Multiple contaminants	↑ Respiratory symptoms, headache, fatigue, heart problems
Wells G&H (Woburn), MA	294	Water usage in residents with Pb, As, TCE in well water	↑ Leukemia, perinatal mortality, birth defects, childhood sickness
McKin CO., ME	33	Residents exposed to TCE in well water	NR
E.I. Du Pont De Nemours & CO., INC. (Montague Plant), MI	P	Residents exposed to multiple contaminants in well water & fish	NR
"PCB Site in Mich.", MI	NL	Serum PCB levels in exposed & control residents	Altered immune function, no skin, liver problems
St. Regis Paper CO., MN	133	NR	NR
Perham Arsenic Site, MN	411	Hair arsenic levels in exposed residents	Neuropathy & intestinal disorders

SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES (Continued)

<u>SITE</u>	<u>NPL#</u>	<u>EXPOSURES</u>	<u>RESULTS</u>
Times Beach/Shenandoah Stables, MO	366 663	Exposed & control areas 2,3,7,8- TCDD sprayed on soil	Altered liver & immune function tests
Lipari Landfill, NJ	1	Exposed & control areas Multiple contaminants	NR
Price Landfill, NJ	6	Exposed & control areas Multiple contaminants in well water	↑ Eye irritation, rash, tiredness, muscle pain, nausea, pregnancy problems
"GEMS" Landfill, NJ	12	Exposed & control areas Multiple contaminants	↑ Respiratory symptoms, nosebleeds, headaches, nausea, no ↑ reproductive, pulmonary effects
Krysowaty Farm, NJ	103	Exposed & control areas Multiple contaminants in well water	↑ Tiredness for women, no ↑ numerous other reported symptoms
Universal Oil Prod. (Chem. Div.), NJ	108	Exposed & control children Benzene, TCE	↑ Leukemia & Hodgkins disease
Reich's Farms, NJ	122	Residents exposed to multiple contaminants in well water	No association between illness & well water use
Jackson Township Landfill, NJ	407	Residents exposed to multiple contaminants in well water	↑ Skin, kidney problems, hospitalization; no ↑ reproductive problems
Pomona Oaks Residential Wells, NJ	600	Residents exposed to Benzene & Volatile Organics	↑ Cancer risk through inhalation of contaminated shower water
Sussex County Municipal Utility Authority, NJ	NL	Exposed & control areas multiple petroleum contaminants	↑ Headaches, sore throats, eye irritation, altered immune system, no ↑ olfactory loss

SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES (Continued)

<u>SITE</u>	<u>NPL#</u>	<u>EXPOSURES</u>	<u>RESULTS</u>
GE Moreau "Caputo", NY	52	NR	NR
Love Canal, NY	139	Exposed & control areas multiple contaminants	↑ Spontaneous abortions, LBW infants; no ↑ leukemia, cancer, chromosome aberrations
Hooker (Hyde Park), NY	510	Blood pesticide levels in exposed residents	↑ Gastrointestinal symptoms, cough, benign tumors
Brookfield Avenue Landfill, NY	NL	Exposed & control areas Multiple contaminants	↑ Cough, headache, nausea, URI, sinusitis, medication; no ↑ doctor visits, hospitalization
Woodstock, NY	NL	Residents exposed to asbestos in drinking water	NR
Drake Chemical, PA	394	Exposed & control areas Multiple contaminants	↑ Cancer, skin problems, sleepiness; no ↑ birth defects, numerous reported symptoms
Wade (ABM), PA	452	Residents exposed to Multiple contaminants	No ↑ neurologic, hematologic, liver abnormalities
Old City of York Landfill, PA	540	NR	NR
Stanley Kessler, PA	544	Urine levels of TCE metabolites in exposed residents	No acute illness reported
North Hollywood Dump, TN	95	Exposed & control areas Multiple contaminants	↑ Heart murmur, cough, urinary infection, mental illness, arthritis, digitalis medication; no ↑ numerous other symptoms

SUMMARY OF HEALTH STUDIES OF HAZARDOUS WASTE SITE COMMUNITIES (Continued)

<u>SITE</u>	<u>NPL#</u>	<u>EXPOSURES</u>	<u>RESULTS</u>
Velsicol Chem. (Hardeman County), TN	200	Exposed & control residents Multiple contaminants in well water	↑ Altered liver function; No ↑ altered renal funtion, skin or eye problems
"Lead Smelter in Texas", TX	NL	Blood lead levels in Exposed & control children	↓ Motor response, intelligence scores
"Arsenic Site", VA	NL	Urine arsenic levels in exposed residents	Gastroenteritis, Encephalopathy, Nephropathy, Hepatitis
Commencement Bay, Near Shore/Tide Flats, WA	329	Urine arsenic levels in exposed residents	No ↑ absenteeism, hearing loss, birth defects, low birthweight infants
Kanawha County, WV	NL	Exposed & control areas vinyl chloride monomer	↑ Central nervous system malformations in newborns
"Phenol Spill", WI	NL	Exposed & control areas Phenols in well water	↑ diarrhea, mouth sores, burning mouth; no ↑ symptoms after 6 months